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Reconstructive

Therapeutic Mammoplasty and Dermal Flap: A Novel Hybrid Approach for Chest Wall Reconstruction

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Background: Breast reduction techniques in management of breast cancer have been described since 1980 mainly to resect a large tumor in large breasts. Driven by the demand for more aesthetically acceptable results without compromising oncological safety, these oncoplastic approaches have become more popular. In addition, the utilization of redundant lower pole dermal flap has been a widely practiced tool in the armamentarium of implant-based breast reconstruction in patients with large ptotic breasts. The authors advocate a novel hybrid technique utilizing both therapeutic mammoplasty and lower breast pole dermal flap to provide coverage for anterior chest wall defect posttumor resection in patients with large or ptotic breasts.

Methods: A retrospective review was conducted on patients who underwent chest wall resection and reconstruction using therapeutic mammoplasty and dermal flap to provide soft tissue coverage in the period between 2012 and 2018. Patient's demographics, clinicopathological, radiological, operative details, postoperative morbidity, and follow-up data were recorded.

Results: Nine patients with chondrosarcoma (7/9) and giant cell tumor (2/9) were managed with a mean age 44.1 years (range 28–73). Complete oncological resection was achieved in all patients followed by rigid/nonrigid skeletal reconstructions. All procedures were completed successfully with no nipple areolar complex (NAC) necrosis or prosthesis failure experienced during the follow-up period (range 12–72 months). Excellent functional and aesthetic outcomes were reported in all patients.

Conclusion: The authors' results demonstrate that this technique could be safely planned for soft tissue coverage postchest wall resection with superior aesthetic and durable outcomes. *(Plast Reconstr Surg Glob Open 2020;8:e2593; doi: 10.1097/GOX.0000000000002593; Published online 23 March 2020.)*

INTRODUCTION

The evolution of oncoplastic breast surgery, particularly reduction therapeutic mammoplasty (TM) procedures, has grown over the years due to the demand for more aesthetically acceptable results.[1–9] Furthermore, patients with redundant breast skin envelopes have benefited from utilizing the lower breast pole de-epithelized skin [dermal flap (DF)] in providing additional coverage to protect the prosthesis in implant-based breast reconstruction with more predictable outcomes.[10,11] Notably, the tenets of the multidisciplinary thoracic oncoplastic approach are ostensibly established in the literature gaining more popularity driven by high level of patient satisfaction.[12–14] Acknowledging the advantages of both techniques (TM and DF), the authors have principally combined them to achieve a novel hybrid approach for chest wall reconstruction postresection of primary

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chest wall tumors (CWTs). This would improve the functional and aesthetic results without jeopardizing the oncological outcome. This article describes the technique and the outcome which to the authors' best of knowledge would the first time to describe in this context.

MATERIALS AND METHODS

Prospectively collected data from 9 consecutive patients in the period between January 2012 and June 2018 were reviewed and assessed retrospectively. The indications included women with moderate or large breasts presenting with an anteriorly located primary CWT. They were managed through a thoracic oncoplastic multidisciplinary team approach to optimize their perioperative treatment plan.

The patients' demographics, comorbidities, tumor characteristics, and the radiological diagnostic work-up were documented. The operative details, postoperative outcomes, patient's satisfaction survey, and follow-up were recorded. The 2-team single-stage approach for surgical resection and reconstruction for CWT using TM and DF is demonstrated in Figures 1–4 (**see figure, Supplemental Digital Content 1**, which displays: (A) preoperative photograph for a 34-year-old patient [body mass index (BMI): 40 and active smoker] with breast cup size J and grade III ptosis. B, Intraoperative photograph demonstrating the anterior chest wall defect (300 cm^2) post en-bloc resection of tumor and adjacent ribs exposing the intrathoracic viscera and diaphragm. Note the rigid skeletal reconstruction using methylmethacrylate mesh (MMM) in preparation to be secured to the edge of the defect. Of note, a superomedial NAC pedicle was designed with breast tissue of 700 g resected from each side. C, Intraoperative photograph demonstrating the insetting of the inferiorly based DF over the MMM and suture of its cephalic free border to the inferolateral edge of the pectoralis major muscle, thus providing complete coverage of the mesh. D, Intraoperative photograph postwound closure and applying Incision negative pressure wound therapy (iNPWT) (Prevena Dressing; Kinetic Concepts, Inc., San Antonio, Tex.) to promote healing in this high-risk wound due to risk factors (BMI 40 and active smoker). E, Postoperative photograph 24 months showing healing of scars with primary intention, complete survival of the NAC on both sides with satisfactory shape and symmetry of both breasts, **http://links.lww.com/PRSGO/B342**).

(**See Video [online]**, which displays the multidisciplinary two-team approach for en-bloc resection of a right anterior chest wall chondrosarcoma in a 29-year-old patient. Strattice ADM was used to restore the skeletal chest wall integrity, while soft tissue coverage was achieved using the wise pattern TM and DF with simultaneous contralateral symmetrization reduction mammoplasty.)

RESULTS

The patient and tumor characteristics, operative details, follow-up period, and outcomes are summarized in Table 1. Their age ranged from 28 to 73 years (mean 44.1), whereas the BMI ranged from 27 to 41 kg/m^2 (mean 32.7). Chondrosarcoma was the commonest pathology (7/9), whereas giant cell tumor was in (2/9) cases. A wise pattern approach TM was performed in all patients. The superomedial NAC pedicle was the commonest performed (6/9) followed by superior pedicle (2/9) and superolateral (1/9). Breast tissue was resected in 66.6% (6/9) of the patients at the primary surgery with a range of 56–1,200 g (mean 424), whereas 33% (3/9) required only mastopexy. Contralateral breast symmetrization was performed in (7/9) [6 reductions and 1 mastopexy] [5/7 simultaneously and 2/7 subsequent second stage]. The DF was inferiorly based on all patients except one which was superiorly based due to the location of the tumor caudal to the inframammary fold. The numbers of the ribs resected were between 2 and 4 (median 3) with resultant defect size ranged from 90 to 300cm^2 (mean 138). Adequate clear surgical margins were achieved in all patients. The resultant defect was repaired using MMM in (5/9), acelluar dermal matrix (Strattice, Lifecell, Allergan, N.J.) in (2/9), and polyprolene mesh (PPM) in (2/9). iNPWT (Prevena dressing) was used in high-risk patients (3/9) due to morbid obesity, diabetes, and smoking. During the follow-up

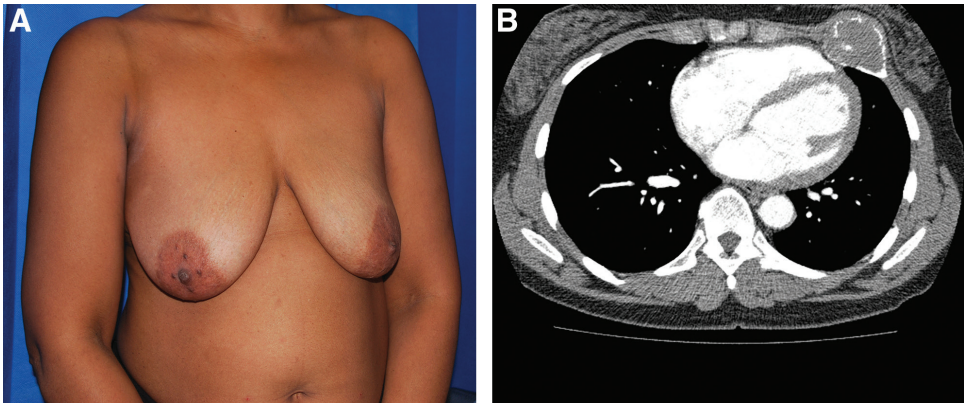

Fig. 1. A 47-year-old patient with a giant cell tumor in the anterior left chest wall. A, preoperative photo showing breasts, cup size C, with grade III ptosis. B, CT scan of the thorax revealing a giant cell tumor of the left fourth rib in midclavicular line.

Fig. 2. Intraoperative photograph demonstrating the wise pattern TM approach with superior pedicle NAC and de-epithelization inferior breast pole skin to create an inferiorly based DF. Note the nonrigid skeletal reconstruction for the anterior chest wall defect (150 cm^2) with PPM post en bloc resection of tumor and adjacent ribs.

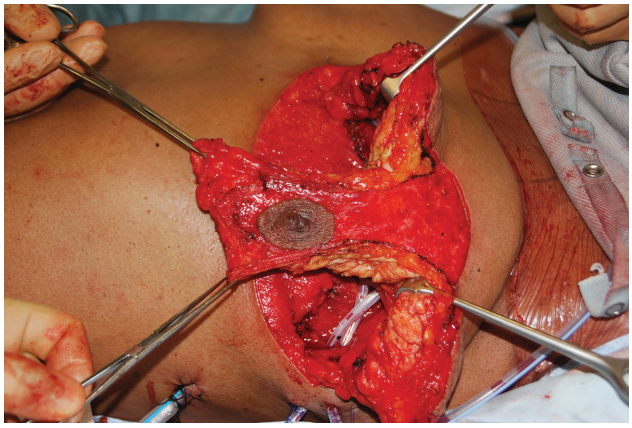

Fig. 3. Intraoperative photograph demonstrating the insetting of the inferiorly based DF over the PPM and suture of its cephalic free border to the inferolateral edge of the pectoralis major muscle thus providing complete coverage of the mesh. Note the superior pedicled NAC that will be transposed to its new position as part of the Wise pattern mastopexy.

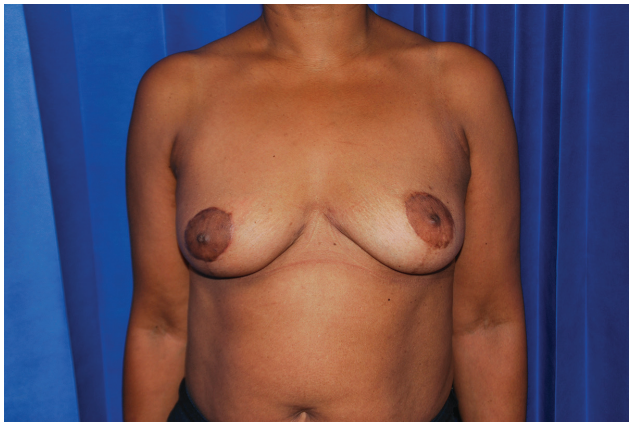

Fig. 4. Postoperative photograph 18 months after the second-stage right contralateral symmetrization mastopexy showing healing of scars with primary intention, complete survival of the NAC on both sides with good shape and symmetry of both breasts.

period of 12–72 months (median 31), there was no local recurrence or mortality experienced. One patient experienced a superficial T junction breakdown which was managed conservatively; no surgical site infection (SSI) was encountered. All patients experienced complete survival of NAC with excellent functional and aesthetic results and high satisfaction rates.

DISCUSSION

The patient-driven evolution of the oncoplastic reduction mammoplasty for the management of breast cancer has, respectively, become popularized over the past 2 decades due to the demand for better functional and aesthetic results.[1–8] Furthermore, more recent studies have broadened the indications and introduced the concept of extreme oncoplasty technique for management of locally advanced breast cancer.[9] Along these lines, the authors advocated similar approach to manage female patients with anterior chest wall chondrosarcoma and giant cell tumors. Notably, these patients have excellent disease-free and survival rates with surgery considered the cornerstone of their management.[15] Nevertheless, chest wall resection and reconstruction using conventional methods could be debilitating with less favorable functional and aesthetic outcomes.[16] The ideal patient would be one with a moderate or large breast who will benefit from reduction or mastopexy with a moderate anterior chest wall skeletal defect post tumor extipiration. In this study, the majority of the patients were young and active, preferring a less invasive approach with attention to the aesthetic results without compromising the oncological outcome. Similarly, previous studies demonstrated the concept for providing the opportunity to design incisions that provide muscle sparing approaches and more aesthetically acceptable results with improvement of patient's satisfaction and overall quality of life.[14,17,18] We have previously demonstrated the value and importance of the multidisciplinary approach for chest wall resection and reconstruction to provide complete well-vascularized coverage to minimize the SSI.[14,19] A step ahead is to achieve this goal with muscle sparing approach avoiding functional deficit with better quality of life. DF has proven to be valuable in coverage of breast implants for breast reconstruction.[10,11] Hence, we combined DF with TM as a muscle sparing approach to provide coverage and protection of the prosthesis used for either rigid or nonrigid skeletal reconstruction. Acknowledging the well-established indications for iNPWT reported in the literature,[20] we have extended its application in thoracic oncoplasty procedures, which has proved to be valuable in high-risk patients. Although the most significant finding in this series is that all patients' treatment was completed without any SSI or NAC necrosis, there are limitations to this study due to its retrospective nature, single-center experience with small sample size, and the relatively medium follow-up period. The proximate collaboration between thoracic and oncoplastic surgeons to achieve a satisfactory oncological outcome along with the best aesthetic results is imperative. Therefore, the authors believe that this multidisciplinary approach could

Table 1. Patient and Tumor Characteristics, Operative Details, and Follow-up Period

Patient	Age (years)	BMI	Comorbidities	Breast Cup Size and Degree of Ptosis	Histopathology and Tumor Site	NAC Pedicle and Dermal Flap Base	Resected Breast Tissue	Skeletal Defect Size (cm^2)	Modality of Skeletal Reconstruction	Contralateral Symmetrization Reduction or Mastopexy	Follow-up (months)
1	53	41	Crohn's Disease	J Grade III ptoisis	Chondrosarcoma anterior chest wall left third rib mid-clavicular line	Supero medial NAC pedicle and inferiorly based DF	1200 g	100	PPM	Yes, separate second stage reduction mammoplasty	72
2	31	35	Ex-smoker Previous bilateral reduction mammoplasty	F Grade III ptosis	Chondrosarcoma mid and lower Sternum + adjacent costochondral junction	Bilateral Superior lateral NAC pedicle and inferiorly based DF	390 g	115	MMM	Yes, simultaneous reduction mammoplasty single stage	54
3	28	27	None	DD Grade III ptosis	Giant cell tumor anterior chest wall right second rib mid-clavicular line	Supero medial NAC pedicle and inferiorly based DF	No breast tissues resected Only skin reduction (mastopexy)	90	Strattice (ADM)	Yes, simultaneous mastopexy single stage	19
4	47	32	None	C Grade III ptosis	Gaint cell tumor anterior right 4^{th} rib between mid-clavicular and anterior axillary line	Superior NAC pedicle and inferiorly based DF	No breast tissues resected Only skin reduction (mastopexy)	150	PPM	No (patient choice)	34
5	31	29	None	D Grade III ptosis	Chondrosarcoma anterior chest wall right third between mid-clavicular and mid line	Supero medial NAC pedicle and inferiorly based DF	No breast tissues resected Only skin reduction (mastopexy)	120	MMM	No, (patient choice)	48
6	71	30	Hypertensive exsmoker	D Grade III ptosis	Chondrosarcoma anterior chest wall left third between mid-clavicular and mid line	Superior NAC pedicle and inferiorly based DF	80 g	120	MMM	Yes, simultaneous reduction mammoplasty single stage	31
7	73	30	Arrhythmia	E Grade III ptosis	Chondrosarcoma anterior chest wall left costal margin	Supero medial NAC pedicle and superiorly based DF	120 g	150	Strattice (ADM)	Yes, simultaneous reduction mammoplasty single stage	18
8	29	31	None	D Grade III ptosis	Chondrosarcoma anterior chest wall 3^{rd} mid-clavicular line	Supero medial NAC pedicle and inferiorly based DF	56 g	100	MMM	Yes, simultaneous reduction mammoplasty single stage	20
9	34	40	Diabetic smoker	J Grade III ptosis	Chondrosarcoma	Supero medial NAC pedicle and inferiorly based DF	700 g	300	MMM	Yes, simultaneous Reduction mammoplasty	12

ADM, acellular dermal matrix; PPM, polyprolene mesh; TM, therapeutic mammoplasty.

be added to the repertoire of techniques described in the literature for chest wall resection and reconstruction. It is safe, less invasive with superior aesthetic and functional outcome, and better quality of life when compared to conventional approaches.

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REFERENCES

1. Clough KB, Lewis JS, Couturaud B, et al. Oncoplastic techniques allow extensive resections for breast-conserving therapy of breast carcinomas. *Ann Surg*. 2003;237:26–34.
2. Losken A, Pinell XA, Eskenazi B. The benefits of partial versus total breast reconstruction for women with macromastia. *Plast Reconstr Surg*. 2010;125:1051–1056.
3. Clough KB, Kroll SS, Audretsch W. An approach to the repair of partial mastectomy defects. *Plast Reconstr Surg*. 1999;104:409–420.
4. Losken A, Hart AM, Broecker JS, et al. Oncoplastic breast reduction technique and outcomes: an evolution over 20 years. *Plast Reconstr Surg*. 2017;139:824e–833e.
5. McCulley SJ, Macmillan RD. Planning and use of therapeutic mammoplasty–Nottingham approach. *Br J Plast Surg*. 2005;58:889–901.
6. McCulley SJ, Durani P, Macmillan RD. Therapeutic mammaplasty for centrally located breast tumors. *Plast Reconstr Surg*. 2006;117:366–373.
7. McCulley SJ, Macmillan RD. Therapeutic mammaplasty–analysis of 50 consecutive cases. *Br J Plast Surg*. 2005;58:902–907.
8. Schaverien MV, Raine C, Majdak-Paredes E, et al. Therapeutic mammaplasty–extending indications and achieving low incomplete excision rates. *Eur J Surg Oncol*. 2013;39:329–333.
9. Silverstein MJ, Savalia N, Khan S, et al. Extreme oncoplasty: breast conservation for patients who need mastectomy. *Breast J*. 2015;21:52–59.
10. Hammond DC, Capraro PA, Ozolins EB, et al. Use of a skin-sparing reduction pattern to create a combination skin-muscle flap pocket in immediate breast reconstruction. *Plast Reconstr Surg*. 2002;110:206–211.
11. Goyal A, Wu JM, Chandran VP, et al. Outcome after autologous dermal sling-assisted immediate breast reconstruction. *Br J Surg*. 2011;98:1267–1272.
12. Gonfiotti A, Santini PF, Campanacci D, et al. Malignant primary chest-wall tumours: techniques of reconstruction and survival. *Eur J Cardiothorac Surg*. 2010;38:39–45.
13. Mansour KA, Thourani VH, Losken A, et al. Chest wall resections and reconstruction: a 25-year experience. *Ann Thorac Surg*. 2002;73:1720–1725; discussion 1725.
14. Khalil HH, Malahias MN, Balasubramanian B, et al. Multidisciplinary oncoplastic approach reduces infection in chest wall resection and reconstruction for malignant chest wall tumors. *Plast Reconstr Surg Glob Open*. 2016;4:e809.
15. Fromm J, Klein A, Baur-Melnyk A, et al. Survival and prognostic factors in conventional central chondrosarcoma. *BMC Cancer*. 2018;18:849.
16. Moscona RA, Fodor L, Ben-Nun A, et al. Never say no to a damaged muscle: the applications of previously damaged pectoralis major and latissimus dorsi muscles for chest wall reconstruction. *Ann Plast Surg*. 2006;56:156–159.
17. Basta MN, Fischer JP, Lotano VE, et al. The thoracoplastic approach to chest wall reconstruction: preliminary results of a multidisciplinary approach to minimize morbidity. *Plast Reconstr Surg*. 2014;134:959e–967e.
18. Hamdi M, Dancey A. The septum-based therapeutic mammaplasty technique for management of sternal defects. *Plast Reconstr Surg*. 2010;125:569–573.
19. Khalil HH, Kalkat M, Malahias MN, et al. Chest wall reconstruction with porcine acellular dermal matrix (Strattice) and autologous tissue transfer for high risk patients with chest wall tumors. *Plast Reconstr Surg Glob Open*. 2018;6:e1703.
20. Webster J, Liu Z, Norman G, et al. Negative pressure wound therapy for surgical wounds healing by primary closure. *Cochrane Database Syst Rev*. 2019;3:CD009261.